CHAPTER III.

DISEASES OF THE NERVES SUPPLYING THE OCULAR MUSCLES—I. E., THE THIRD (MOTOR OCULI), THE FOURTH (PATHETICUS), AND THE SIXTH (ABDUCENS).

THE third nerve emerges from the brain at the inner margin of the crus close to the anterior border of the pons; it passes obliquely forward and outward, reaches the outer wall of the cavernous sinus, enters it, and then divides into two branches, which, passing through the sphenoidal fissure, enter the orbit. The upper division, which supplies the levator palpebræ superioris and the rectus superior, is the smaller of the two. Of the three branches of the lower division, the one supplying the inferior oblique is the longest; the two others, one of which goes to the inferior rectus, the other to the internal rectus, are shorter. The longest branch, that of the inferior oblique, gives off a short root to the ciliary ganglion, the filaments of which are distributed to the ciliary muscle (tensor choroideæ) and to the constrictor of the iris (sphincter pupillæ); consequently these intrinsic muscles of the eyes also are innervated by the third nerve, while the dilator pupillæ, on the other hand, is provided for by the sympathetic.

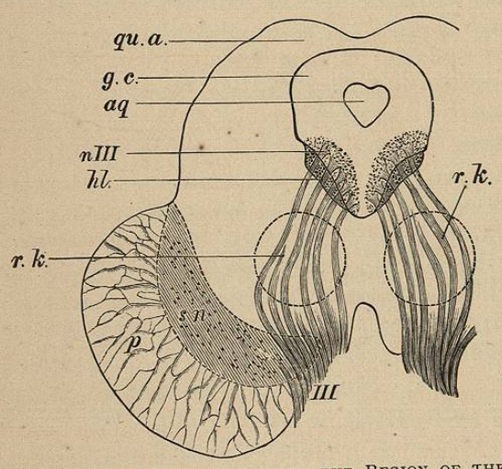

Fig. 6.—CROSS SECTION THROUGH THE REGION OF THE ANT. CORPORA QUADRIGEMINA.

qu.a. anterior corpora quadrigemina; *g.c.* gray matter around the aqueduct of Sylvius; *aq*, aqueduct of Sylvius; *nIII* nucleus of the third nerve; *hl.* posterior longitudinal bundle; *r. k.* red nucleus (tegmentum); *sn*, substantia nigra (locus niger); *p*, cerebral peduncle.

The nuclei of the third nerve, a column of multipolar ganglionic cells, lie above the posterior longitudinal bundle, between it and the aqueduct of Sylvius, and the root fibres coming from them divide into several fasciculi, pierce the posterior longitudinal bundle, the tegmentum, with the red nucleus and the substantia nigra, and emerge from the brain at the place shown above (cf. Fig. 6).

Experimental as well as clinical observations seem to indicate that in the collection of ganglionic cells of this nerve nucleus there exist three centres, the anterior of which is the centre for the ciliary muscle (accommodation); the next the centre for reflex stimulation of the iris by light; the third, by far the largest, the centre for the extrinsic ocular muscles (Gowers). Observers, however, by no means agree with regard to the number and position of the individual oculo-motor nuclei or centres. The view held by Gowers is diagrammatically illustrated in Fig. 7.

That there exists a cortical centre for the ocular muscles and the levator palpebrarum is beyond question; nothing certain is, however, known about its situation; most probably it lies in the upper or lower parietal lobe (cf. Exner, Untersuchungen über die Localisation der Functionen in der Grosshirnrinde des Menschen. Wien, Braumüller, 1881, p. 42).

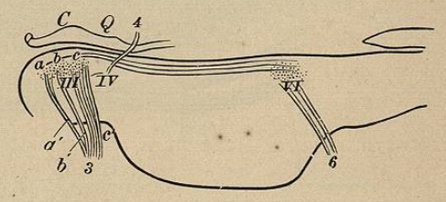

Fig. 7.—DIAGRAMATIC LONGITUDINAL SECTION THROUGH THE PONS WITH THE NUCLEI OF THE OCULAR NERVES. (After GOWERS.) *C. Q.* Corpora quadrigemina; *a a' b b'* and *c c'* represent the centres and the nerve-fibres; *a*, for accommodation, *b*, for the reflex activity of the iris, *c*, for the extrinsic ocular muscles; all three are contained in the oculomotorius. *IV*, pathetic. *VI*, abducens.

The fourth, the trochlear or pathetic nerve, is the smallest of the cranial nerves, but has the longest course within the skull cavity. It leaves the brain close behind the corpora quadrigemina at the upper surface of the valve of Vieussens; from here it takes a lateral and downward course, winds around the outer side of the crus cerebri, and reaches the base of the brain. Its course is now forward; piercing the dura mater behind the anterior clinoid process, it reaches a small channel of the cavernous sinus, and runs alongside of the third to the sphenoidal fissure, pierces its fibrous membrane, and finally enters the superior oblique muscle.

The nucleus of the fourth lies behind the collection of cells from which emanates the third nerve (Wernicke), to the ventral side of the aqueduct of Sylvius, on the posterior longitudinal bundle, in the gray matter around the aqueduct. From this nucleus the root

originates, which, passing to the mesial side of the descending root of the fifth (Fig. 8, Vd), extends as a round bundle (IV′) to the posterior corpus quadrigeminum; in the substance of the valve of Vieussens it is crossed by the nerve of the opposite side, and emerges finally in the above-described manner on the side opposite to that in which its nucleus is situated.

The sixth nerve, the abducens, leaves the brain at the posterior margin of the pons, between it and the anterior pyramid. It

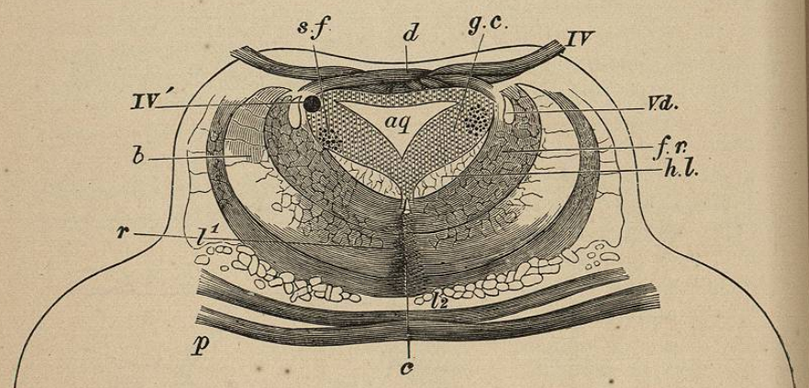

Fig. 8.—Cross-section through the Region of the Tegmentum. (After Schwalbe.) *d*, patheticus-crossing. *IV*, Patheticus at its exit. *IV′* cross-section of the patheticus in its course to the nucleus. *V.d.* descending root of the trigeminus (cross-section); *aq*, aqueduct, *g. c*, central gray substance around the aqueduct, *s.f*, substantia ferrugin. *b*, sup. peduncle of cerebellum crossing at *c*; *r*, raphe; *f.r.* formatio reticularis; *h.l.* posterior longitudinal bundle.

takes at once a forward course and passes into the cavernous sinus, piercing its posterior wall; it then runs, surrounded by the dural sheath, alongside of the internal carotid, and, emerging through the sphenoidal fissure, enters the external rectus, in the substance of which it breaks up into branches.

The nucleus of the abducens, which was at one time thought to be connected with the root of the facial nerve (hence the facial-abducens nucleus of Meynert and Stilling), lies in the floor of the fourth ventricle, from which it is separated by the ependyma. The abducens root, passing through the peduncular portion of the pons to the outer side of the pyramids into the tegmental region of the pons to the median side of the upper olive, finally enters this nucleus (cf. Fig. 9). The tegmentum behind the lemniscus is divided into three parts by the abducens (and facial) root, the inner two of which Meynert has called the motor region of the tegmentum.

The affections of the nerves supplying the ocular muscles belong, strictly speaking, also to the domain of ophthalmology. Since, however, they are of such importance for the diagnosis and the prognosis in certain nervous diseases (e. g., tabes), it is necessary to devote a few pages at least to the description of their symptoms and the proper methods of examination.

The independent diseases of the muscles of the eyes may be of a paralytic or of an irritative (spastic) nature, the latter

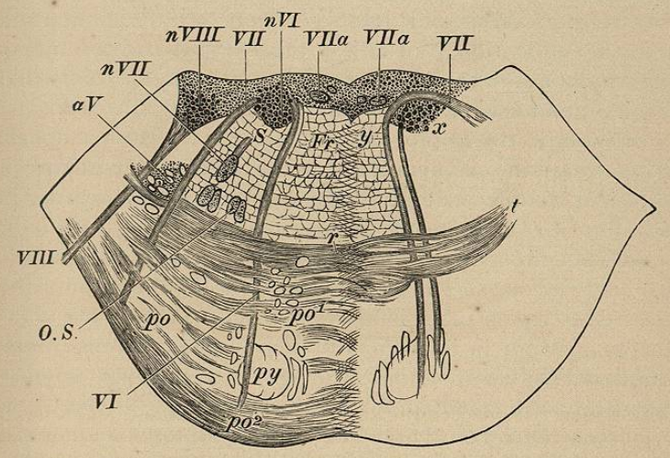

Fig. 9.—Cross-section through the Pons. (After Schwalbe.) *n VI*, abducens nucleus. *VI*, abducens. *O.S.*, upper olive. *aV*, ascending root of trigeminus. *n VII*, nucleus of facial. *n VIII*, auditory nucleus (so-called external nucleus). *VII*, emerging portion of facial root. *po*, transverse fibres of the pons which are divided into superficial *po*¹ and deep *po*². *py*, pyramidal tract.

class, however, being by far the less frequent of the two. Their seat may be central or peripheral, although we should state that an undoubted central affection of the abducens and of the patheticus has never been observed. Of oculo-motor paralysis, we are acquainted with a peripheral and a central form.

A peripheral affection may have its seat in the stem or in its branches; a central, in the nucleus or the (supposed) cortical center of the nerve. The former will be characterized by the absence of all cerebral symptoms, which, in the central form, are almost always present. It can be brought about by pathological changes in the orbit, in which case the eyeball not infrequently protrudes and becomes immobile. Further, it may develop as a rheumatic paralysis from exposure to cold

(*a frigore*); also in constitutional syphilis, in diphtheria and other acute infectious diseases, in meat poisoning, and as the result of alcoholic excesses; exceptionally it is seen after traumatism. In one of my cases a man was kicked by a cow in his right eye; after the acute symptoms had passed off, a paralysis of the levator palpebræ superioris remained for months. Power of vision was not interfered with.

The central paralysis is met with in the course of meningitis, multiple sclerosis, progressive bulbar paralysis, and, above all, locomotor ataxia. It rarely affects all the ocular muscles at the same time, but either the extrinsic or the intrinsic alone (cf. Knies, Ueber die centralen Störungen der willkürlichen Augenmuskeln, Arch. für Augenhk., 1891, xxiii, 1, p. 19). Although the diplopia of tabetics is neither a constant nor a pathognomonic symptom of the disease, the occurrence of transient double vision in otherwise apparently healthy persons ought always to make us suspicious, and ought to induce us to subject the patient to a more careful examination. The nature as well as the anatomical seat of this oculo-motor paralysis occurring in tabes is entirely obscure. A monocular diplopia may occur in hysterical patients; owing to disorders of accommodation two or more images are thrown upon the retina (Bouveret et Chapetot, Revue de méd., 10 Sept., 1892, p. 728; and Duret et Dujardin, Sur la diplopie monoculaire comme symptôme cérébral, Journal des sciences méd. de Lille, 1892).

Of the cortical oculo-motor paralysis we know little or nothing; the only well-established fact is that an isolated paralysis of the levator palpebræ superioris may be associated with cerebral affections—for instance, with a cerebral hæmorrhage, but the location of the center is not known. Grasset and Landouzy thought it to be in the second temporal convolution (the *pli courbe* of the French writers), but Charcot and Pitres have adduced important reasons against this view. Lately the subject has again been taken up by Lemoine (Revue de méd., 1887, vii, 7). This "blepharoptosis cerebralis" needs much further investigation.

Isolated ptosis may be unilateral or bilateral; it may be acquired or congenital. Of the latter form Siemerling has published a case, with autopsy, in which he found degenerative changes in the main cell group of the ventral as well as the dorsal oculo-motor nucleus (Arch. f. Psych., 1892, xxiii, 3, p. 764). It is interesting to note that some patients with ptosis are able to open their eyes if they put into activity certain muscles supplied by the trigeminus—for example, the muscles of mastication.

Acquired ptosis is not always due to an affection of the third nerve, but may be the result of a primary atrophy of the levator palpebræ superioris. Fuchs has reported a number of such cases (Arch. f. Ophthalm., 1890, xxxvi, 1, p. 234). Dutil has described two cases of ptosis in the same family. (Note sur une forme de ptosis non congénital et héréditaire, Progrès méd., 1892, 2 S., xvi, 46). The duration of the disorder varies. I have notes of several patients in whom ptosis existed for years, and in whom no other, spinal or cerebral, symptoms developed. A very complete paper on the ætiology and the ætiological diagnosis has lately been published by Dalichow from Senator's clinic (Zeitschr. f. klin. med., 1893, xxii, 4, 5).

In studying the symptoms of the paralyses of the ocular muscles we shall first consider those of the oculo-motor paralysis, more especially of the complete form, in which all branches of this nerve are implicated.

The upper eyelid droops completely, and the eye can only be opened slightly by the aid of the frontalis; the movements of the eyeball are also at fault; the eye, deviated outward as it is, can not be moved toward the nose; similarly any upward motion is impossible, as such depends upon the superior rectus and the inferior oblique. On the other hand, the outward movements are unhampered (rectus externus), while the downward motion is performed by the superior oblique, the pure action of which can here be well studied, the rectus inferior, which otherwise also assists in the downward motion of the bulb, being now inactive.

From the different directions of the axes of the two eyes there results a very apparent symptom, namely, strabismus, which may be convergent or divergent, according to the muscles affected. This strabismus, due to paralysis of the ocular muscles (paralytic), differs from that caused by spasm (spasmodic), inasmuch as (1) in the latter the deviation exists with all movements, while in the former only with those which call into action the paralyzed muscle; (2) in spasmodic strabismus the secondary deviation of the sound eye, of which we shall presently speak (cf. p. 51), does not occur.

The double vision, "diplopia," which is associated with strabismus, is especially marked at the beginning of the disturbance, before the patient has learned to suppress the "false image" seen with the affected eye, and only to pay attention to the "true image" seen with the healthy one (cf. Amon, Ueber Diplopie, Münchener med. Wochenschrift, 1890, 46). At first these double images cause him much annoyance, until later on he learns to close the affected eye by contraction of the orbicularis, or to put the head into a position in which the affected muscle is not called into play. By these devices he not only avoids the unpleasantness of the double images, but also the consequences which the erroneous projection of the visual field entails, namely, a peculiarly disagreeable feeling of dizziness, the so-called ocular or visual vertigo, to which we shall have occasion to refer again.

With reference to the pupillary symptoms we must keep in mind the reactions present in a normal eye: the pupil reacts directly to changes between light and darkness, contracting if light is thrown into the eye, and indirectly in that the pupil of one eye dilates if the other is covered; it also reacts on motions of convergence and on forced accommodation, contracting in either case. All these reactions are lost in complete paralysis of the third nerve. The pupil is moderately dilated and gives no response to the influence of light or accommodation; if the paralysis is incomplete, and either the sphincter of the iris or the ciliary muscle, or both, are intact, so that in the latter case only the extrinsic muscles do not perform their function, the size of the pupil can vary and accommodation be retained.

The reflex immobility of the pupil (Erb), also called the "Argyll-Robertson pupil"—that is, where the pupil has lost its reaction to light impressions (reflex), but has retained its power of accommodation—is very frequently observed in tabetics. Besides this, the pupil in tabes is often very small, pin-head pupil—spinal myosis.

Inequality of the pupil, anisocoria, is also seen in the course of tabes, in general paralysis, in hemicrania, optic atrophy, separation of the retina, accommodation paralysis, etc. Recke, in the ophthalmological clinic of Magnus in Breslau, has lately pointed out that this symptom need by no means have the ominous significance which has formerly been attributed to it, but that not infrequently it is found associated with astigmatism, myopia, and with presbyopia, especially in men, without the existence of any central disease (Deutsche med. Wochenschrift, 1893, 13).

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Paralysis of the abducens, unilateral or bilateral, which also comparatively frequently accompanies locomotor ataxia, often constituting here the only initial symptom for a long time, is to be recognized by noticing that the eye, which is slightly turned inward, can not be moved outward, while all the other movements are unimpeded. In exceptional cases this is found associated with facial and trigeminal paralysis. The condition is usually congenital. Bernhardt (cf. lit.) has reported cases of this kind, and Möbius in an extensive article gives a careful study of the infantile nuclear degeneration, and has especially called attention to the fact that a large proportion of all ocular palsies are congenital or acquired in early life (Münchener med. Abhandl., 1892, 6. Reihe, Heft 4).

Unilateral paralysis of the abducens has also been observed after fracture of the base of the skull (Köhler, Berliner klin. Wochenschr., 1891, 18).

Unilateral paralysis of the patheticus, which supplies the superior oblique muscle, is always difficult to recognize even when the muscular system of the other eye remains perfect, and can only be diagnosticated after an examination of the nature of the double images. When there is paralysis of the oculo-motorius in the other eye a diagnosis is impossible. The examination ought to be made by an ophthalmologist in order to establish the absence of power in the superior oblique (cf. Halm, Beiträge zur Trochlearislähmung. Tübingen, Moser, 1888). Extremely rare is the bilateral patheticus paresis, which has been noted in some cases of tumor of the pineal gland. The anatomical conditions directly underlying it are not known (Remak).